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ABSTRACT

In this investigation of group problem solving in small groups, performance on a tower-building task was studied in same-sex triads of 141 third grade children exposed to four instructional conditions, each consisting of three phases of six trials each. Instructional conditions were either determinate (i.e., individualistic or contrient reward structures) or indeterminate (i.e., undesignated or no rewards). In Phase One and Three of the task, triad members were equally rewarded (i.e., promotive reward structure). In Phase Two members received rewards according to different instructional conditions. Four measures of group performance were obtained. Two-factor multivariate analyses of variance were conducted, with repeated measures on Phase Two. Results of this study and the reanalysis of a previous study indicate that discrepancy scores between most and least contributing group members increased over time regardless of the instructional condition to which the group was exposed. In regard to indeterminate conditions, the change from promotive to no reward contingencies resulted in the maintenance of cooperative strategies. Change from promotive to undesignated reward contingencies resulted in a shift to individualistic performances. Generally, the children interpreted current task demands in terms of current goals, and transitions between cooperation, competition, and individualization were immediate. Further research into the interaction of contextual factors and immediate goal structures is recommended. (Author/RH)

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Indeterminate and Sequential Goal Structures in Relation to Task Performance in Small Groups

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Running head: Indeterminate Goal Structures and Task Performance

Abstract

Task performance was studied in triads of third grade children exposed to four instructional conditions, each consisting of three phases. During the first and third phases all groups received promotive instructions (equal rewards given to each participant). During the second phase triads received one of four types of instructions: individualistic (rewards allocated proportionate to individual performance); contrient (winner take all); no reward (all rewards suspended); undesignated (participants told that rewards would be allocated, but not to whom). Performance under the no reward condition resembled performance under standard promotive instructions while performance under the undesignated condition resembled that under standard individualistic instructions. This differentiation is discussed in relation to the immediate experimental context (cooperatively oriented) and the larger context of the school (individualistically oriented). There was no carryover of second phase task strategies into third phase performance.

Group problem solving has been defined as "common action taken to attempt to satisfy common interests emerging from common problems" (Kelly & Thibault, 1960, p.2). In studying problem solving in small groups, then, one studies the social processes which arise from the interdependencies among the group members. Each member must take into account the activities of the other, and the outcome will be a product of the interaction among the activities of individual members. The solution to the problem, according to Deutsch (1949; 1962; 1968), may be carried out cooperatively, or not, depending on how the individual members perceive their goals to be interrelated. In a group operating under a promotive interdependent goal structure, individual members believe their respective goal attainments to be positively correlated. Under a contrient interdependent goal structure, group members perceive a negative correlation among their goal attainments; they can achieve their own goals only if other group members fail to reach theirs. Finally, under an individualistic goal structure, goal attainment by other group members is perceived as unrelated to one's own goal achievement. Thus, it is through knowledge and utilization of group goals that individual members effectively coordinate and strategically plan their problem solving behavior.

The first objective of the present investigation was to resolve an issue raised in recent research on sequential goal structures. In two studies (French, Brownell, Graziano, & Hartup, 1977; Sherif, Harvey, White, Hood, & Sherif, 1961), exposure to promotive or individualistic

structures was found to alter the competitive atmosphere ensuing f om a contrient experience. Under such "shift" conditions, however, g oup performance did not reach the same levels as under continuous prom otive or individualistic goal structures (French et al., 1977)[1]. Two ex lana- tions for these results can be offered. First, when goal structur es are employed sequentially, there is the possibility that negative transfer occurs, as evidenced by interference in the establishment of successive strategies and roles. Goldberg and Maccoby (1965) foun d that, in a group problem solving situation, children require a cer tain amount of time to establish both appropriate task strategies and o ptimal interpersonal behavior. Unless the shift groups accomodate immedi ately upon presentation of a different goal structure, established strat egies and roles may be utilized under the new goal structure with less t han optimum results. Alternatively, the failure of the shift groups t o reach the same performance levels as the continuous groups may be a derivative of the experimental design. The shift groups received only half as many total trials under the promotive condition as di d the groups that experienced the continuously promotive goal struct ures. For performance to have reached optimum levels, these groups may h ave required a certain amount of time to practice under conditions pro moting cooperation. A research design was used in the present study that permits a choice between these two hypotheses concerning the seque ntial effects.

A second objective was to examine an additional source of var iance in children's performance in small groups - the clarity of the inf ormation

concerning the interdependencies among group members. In Deutsch's framework, the perceived interdependence among group members motivates and defines the individual's efforts, thus the clarity of the goal structure is essential to effective group activity. Yet many situations are confronted by children, both within and outside the educational system, in which goal structures are not exclusively and explicitly specified as promotive, individualistic, or contrient. How do children interpret unclear feedback, and how are these interpretations reflected in group performance?

Two types of indeterminate goal structures can be cited as theoretically relevant. First, unclear structures are created when no feedback is provided to group members on which to base judgments concerning interdependence. Second, such goal structures emerge when the instructions seem superficially to give specific information regarding the interdependencies among group members, but which actually provide random, conflicting, or ambiguous information (e.g., some members are given rewards for performance, but no one knows who the recipients are). Such circumstances can best be described as creating unspecified or undesignated goal structures.

It was hypothesized that, in the absence of specific feedback, children nevertheless construct interpretations of the social situation upon which they base their problem solving activities. It was further hypothesized that these interpretations are the product of an interaction between the clarity of feedback regarding interdependence and the contextual information available to the children for judging whether cooperation or competition would be the more appropriate course of action in the situation

in which they find themselves. Deutsch (1949) states that the decision to cooperate or not is based on the "effective attractiveness" of cooperation as compared to the perceived alternatives; that attractiveness, in turn, is a function of the desirability of the alternatives and the subjective probability that an alternative will lead to success. Johnson & Johnson (1975) add that children's perceptions of the available alternatives will depend on their past experiences as well as on their perceptions of constraints within the immediate situation. Based on this reasoning, several predictions were made concerning the effects of environmental context on children's use of ambiguous goal structures.

1. When children work under a promotive goal structure and the feedback about their interdependence is discontinued (no goal structure), they will continue in the immediately preceding interactive mode -- at least until they receive contrary feedback. Given a positive and successful experience in the initial promotive interaction, the most attractive alternative for the group members will be to maintain the cooperative interdependence already established.

2. When, following a promotive goal structure, contingencies for individual success and interdependence become ambiguous (although specified), children must appeal to a higher order or more stable source of information to assist in their interpretation of the situation. In this instance, the conditions leading to task success are difficult for group members to apprehend. Hence, it is predicted that children will try to interpret such situations in light of longer term, more reliable experiences (e.g., those within the school or other problem solving situations) insofar as these environments contain elements similar to

the experimental conditions. Assuming that these longer term social contexts are mainly individualistic or contrient, as Johnson and Johnson (1975) and Bryan (1975) believe to be the case in American schools, then competitive strategies would be expected to emerge in ambiguous feedback situations.

Method

Subjects were 78 third grade males and 63 third grade females (mean age approximately 9 years) from two suburban St. Paul, Minnesota, public schools. Children were randomly assigned to 47 same-sex triads, with the restriction that children within a single triad were drawn from different classrooms. Triads were then randomly assigned to one of four goal structures (Phase II): a) individualistic, b) contrient, c) undesignated, d) none.

A tower-building task was adapted from Goldberg and Maccoby (1965). Children in each triad were asked to build a tower collectively with 7.6 cm^3 colored wooden blocks. Since the tower-building task requires coordinated performance for success (e.g., towers fall if built unevenly or bumped), it was felt that the task was appropriate for studying small group interaction. Moreover, previous investigators (French et. al., 1977; Graziano, French, Brownell, & Hartup, 1976; Jensen & Moore, 1976) have successfully utilized this task to assess both competitiveness and cooperation in children's groups.

The experiment was carried out in large classrooms in which three tower-building stations were arranged. Each station consisted of an equilateral triangle (approximately 30.5 cm on a side) and three

adjacent sq uares. Children were each assigned to a square with a set of 10 uniqu ely colored blocks. The towers were built inside the triangle, while the b locks were located in the square. Three triads, one at each station, pl ayed the game simultaneously; these triads were assigned to the same experimental condition to minimize confusion and triad-to-triad inter ference.

Each t riad participated in eighteen trials, administered in three phases of s ix trials each. In Phase I, all triads operated under a promotive g oal structure. In Phase II, triads were exposed to one of four goal s tructures, two of which were indeterminate. During Phase III, all t riads returned to a promotive goal structure. At the end of each trial tokens were awarded on the basis of the number of blocks on the com leted tower. If the tower fell over before the blocks could be counted no tokens were awarded.

Phase I. In the promotive condition, each triad member received the number of tokens corresponding to one-third the total blocks on the group's to wer; each member of the group thus received an equivalent reward bas d on the performance of the group as a whole.

Phase II. 1. Individualistic condition. Each child received one token for each of his or her own blocks contributed to the tower.

2. C ontrient condition. The single triad member who had individually cont ributed the greatest number of blocks to the tower was awarded tokens equ ivalent to the number of his or her own blocks placed; the other two triad members received nothing. No tokens were awarded in the event of a tie in this condition.

3. Undesignated condition. The children were told "not everybody will receive chips every time now," and that the experimenter would "have to look in her special book to see who gets chips." All children were informed that the experimenter would record the number of tokens won after each trial and dispense them at the end of the period. Following each trial, the experimenter pretended to write down the number of tokens each child had accumulated during that trial, and one of three forms of feedback was given:

a) "That time, some of you got some chips, but not all of you."

b) "That time none of you got any chips."

c) "That time everybody got some chips."

The form of feedback was randomly assigned to each of the six trials before the session began. Thus, there was no association between the particular form of feedback received and the status of the tower or the number of individual contributions to it.

4. No reward condition. The children received no reward tokens regardless of the status of the tower, although they were told that the number of blocks individually contributed to the tower would be counted nonetheless; at the end of each trial they were told the number of blocks on the completed tower.

Phase III. All triads resumed work under the promotive goal structure.

An experimenter was seated at each station who recorded the number of times that towers fell over and, at the completion of each trial, recorded the number of blocks on the tower. Following the eighteenth trial, the children who had participated in the no reward and undesignated

conditions in Phase II were awarded six tokens each, to make the total number of prizes won approximately equivalent for children in all conditions. Children who had accumulated three or more tokens after a given trial went to a central table and purchased a prize from an assortment of inexpensive toys. Each prize cost three tokens. The children were then given their toys in a paper bag and escorted to their respective classrooms.

Peformance Measures

Four measures of group performance were obtained. In each case, the triad was the unit of analysis rather than the individual.

1. Blocks. For each triad, the number of blocks placed on completed towers was averaged across the six trials within each phase.

2. Falls. For each triad, the number of times the tower fell over during a given trial was averaged across the six trials in each phase.

3. Alternations. An alternation consisted of a sequence of blocks which comprised successive placement by each of the three triad members in turn, indicated by one block each of the three colors (red, brown, and yellow) positioned adjacently. Alternations could be overlapping; thus it was possible for a single block to be counted as part of three succeeding alternations. The alternations score was the ratio of the number of observed alternations divided by the number of possible alternations in each trial given the height of each tower. This score could range from 0 to 1, with a score of 1 indicating that the children in a triad consistently took turns placing blocks. The score was averaged

across the six trials within each phase.

4. Discrepancy. For each triad, on each trial, the sum of blocks for the child with the fewest total blocks was subtracted from the sum of blocks for the child with the most blocks. The score was averaged across the six trials within each phase.

Results

Although there were no significant sex differences on any of the dependent measures, there was a significant difference between the two elementary schools for number of blocks placed on the completed towers, $F(1,31) = 17.74$, $p < .001$, presumably because the testing room in one school was carpeted while the other was not. The data for schools were combined nonetheless in subsequent analyses since the difference between schools was not conceptually important. Moreover, increasing the error term by combining the data from the two schools biases the statistical tests in favor of the null hypothesis, making a Type I error even less likely at conventional alpha levels.

The dependent variables used in this study were significantly intercorrelated with one another, (see Table 1). For this reason, a

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Insert Table 1 about here

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two-factor (goal structure x phase) multivariate analysis of variance (MANOVA) was conducted, with repeated measures on the second factor, phase. This analysis revealed significant main effects for phase, $F(8,164) = 10.36$, $p < .0001$, and goal structure, $F(12,109) = 2.55$,

$p < .005$, as well as a significant interaction effect, $F(24,287) = 3.28$, $p < .0001$. A two-factor analysis of variance (ANOVA) with repeated measures on phases was then conducted for each of the four dependent measures. The first factor consisted of the goal structures occurring during Phase II (i.e., individualistic, contrient, undesignated, and no reward) while the second consisted of the three phases (i.e., six-trial blocks). Post hoc analyses were conducted using the Neuman-Keuls procedure; differences reported were significant at alpha $< .05$.

The analyses were directed at the following questions: a) Are there differences in performance during Phase II, replicating previous studies using these goal structures (cf., French et al., 1977; Graziano et al., 1976)? b) Are there differences in performance between the no reward and undesignated goal structures, and if so, what is the nature of those differences? c) Is there a carryover effect; namely, is performance in Phase III differentially affected by experience in Phase II, given that practice opportunities under the particular goal structure were held constant?

Insert Figure 1 about here

The univariate analyses revealed a significant difference within subjects for the three phases on Blocks, $F(2,86) = 23.54$, $p < .001$; Falls, $F(2,86) = 25.54$, $p < .001$; Alternations, $F(2,86) = 14.01$, $p < .001$; and Discrepancy, $F(2,86) = 6.36$, $p < .003$ (see Figure 1). Post hoc comparisons indicated that for Blocks and Falls, Phase II performance

exceeded both Phase I and Phase III, with no difference between the latter two. Although the main effect for phase was significant for Alternations, post hoc comparisons revealed no significant differences between phases for this measure. Discrepancy scores, on the other hand, increased monotonically across the three phases; Discrepancy scores in Phase III exceeded both Phase I and Phase II scores.

The univariate ANOVAs also yielded significant differences between the four goal structures for Blocks, $F(3,43) = 3.40$, $p < .03$, and for Falls, $F(3,43) = 9.57$, $p < .001$, as well as a significant interaction effect between phase and goal structure for Blocks, $F(6,86) = 6.59$, $p < .001$; Falls, $F(6,86) = 12.35$, $p < .001$; and Alternations, $F(6,86) = 2.55$, $p < .025$. Post hoc comparisons were carried out within each phase separately (adapted for comparisons of individual cell means, after Keppel, 1973, p. 244) to reveal the locus of differences contributing to the goal structure main effect and the interaction effect. These are detailed below.

Phase I. During the first six trials, all groups operated under a promotive goal structure. In order to test for differential carryover from experience under one type of goal structure to performance under a different goal structure, it was crucial that no differences exist between groups in their respective exposure to the initial goal structure. Post hoc comparisons revealed no between-groups differences for any of the dependent measures within this phase. Thus, prior to Phase II, each triad received equivalent practice under the promotive goal structure in peer interaction, building towers, establishing roles, and

selecting task-related strategies.

Phase II. In this phase, each triad was required to operate under one of four goal structures for six successive trials: a) no reward; b) undesignated; c) individualistic; or d) contrient. Triads operating under individualistic goal structures placed more Blocks ($\underline{M}$ = 5.47) and produced taller towers than did those working under contrient goal structures ($\underline{M}$ = 3.07), with fewer towers falling over (individualistic, $\underline{M}$ = .64; contrient, $\underline{M}$ = 1.65) and more Alternations in block placement (individualistic, $\underline{M}$ = .51; contrient, $\underline{M}$ = .34). The no reward and undesignated goal structures were also differentiated, both from one another and from the individualistic and contrient goal structures. Triads operating under the no reward condition produced taller towers ($\underline{M}$ = 7 89) than did those under the undesignated goal structure ($\underline{M}$ = 6.20), and than those under the individualisitc and contrient goal structures. Triads in the no reward condition also had fewer Falls ($\underline{M}$ = .28) than did those in the individualistic or contrient conditions. There were no significant differences in performance, on any dependent measure, between the undesignated and individualistic conditions. The no reward condition thus produced group outcomes resembling the standard promotive pattern (cf., French et al., 1977; Graziano et al., 1976), while the undesignated condition resulted in performance resembling activity under individualastic goal structures.

As noted above, there was a significant increase in Discrepancy scores across phases. While triads under the contrient goal structure in Phase II exhibited a lower Discrepancy score during that phase relative

to the oth r conditions (see Figure 1), their performance was not greatly attenuated and the interaction between goal structure and phase on this measure wa not significant. It is especially interesting that these goal struc ures, which produced such strong group differences during Phase II o the other measures, produced no significant differences on this one.

How g eneral is this finding? Is increasing role differentiation, as indexed by the Discrepancy score, an outcome of alternating goal structures , or is it a more general phenomenon, dependent on cumulative experience with the task? Data from a previous study were reanalyzed to provide a partial answer to this question. Scores obtained in the continuous promotive and individualistic conditions in the French et al. (1977) study were examined to determine whether Discrepancy scores increase over time under a single goal structure and, if so, whether the degree of increase varies according to the goal structure to which the group was exposed. This analysis consisted of a 2(promotive versus individualistic goal structures) x 2(first six trials versus second six trials) ANOVA with repeated measures on the second factor. The analysis revealed only a main effect for trials, $F(1,24) = 11.35$, $p < .003$. The Discrepancy score was larger during the second six trials ($M = 1.89$) than during the first ($M = 1.25$). This analysis provides support, then, for the present finding that Discrepancy scores increase over time regardless of the goal structure to which a group is exposed.

Phase III. All groups resumed operations under a promotive goal structure during Phase III. No differences were found between goal

structure conditions on any measure in this phase. Thus there is no evidence for a differential effect of previous experience with other goal structures on subsequent performance under promotive conditions.

An analysis of group differences within Phase III alone cannot provide definitive evidence with respect to the carry over question: perhaps experience with an intervening goal structure lowered performance uniformly across each of the incentive conditions. If so, no differences would exist between groups in Phase III, but performance would differ between Phase I and Phase III. As previously reported, though, post hoc analyses revealed no differences between Phase I and Phase III on any dependent variable except the Discrepancy score. And the Discrepancy score, as already noted, seems to be a unique dimension of social interaction, increasing continuously with progressive exposure to the task regardless of incentive condition.

Discussion

Previous analyses of goal structures as determinants of small group interaction were extended in the present study to include indeterminate situations. While Deutsch's (1962) theoretical analysis was purposely constrained to include only idealized situations "which do not have the perturbations and complexities of cooperative and competitive situations found in everyday life," the information available to the individual in many situations does not conform to these idealized models. The goal structures used in this investigation represent variations in constraints or structure that veridically mirror the variability found in the ecology of children's groups.

Results indicate that the children formulated clear performance strategies in these indeterminate situations. When told that the promotive goal structure under which they had been working was to be lifted, and that no goal structure would be in effect subsequently, cooperative strategies were maintained. Apparently, the children continued to perceive themselves as promotively interdependent despite the termination of specific reward contingencies. When the children were told that there was going to be a change in goal structure, but were not given clear information about the exact nature of the change, their strategies shifted. In this circumstance, performance seems to have originated in individualistic goal structures.

The differentiation observed between these ambiguous structures suggests different origins. Interdependencies created within the task itself seem to have carried over when the explicit goal structure ceased totally, i.e., when no alternative structure was provided. Of course, only promotive goal structures were encountered initially in this investigation. Since such structures are usually perceived as "positive," "fair," and "pleasant," where contrient goal structures are perceived in negative terms (Brady, Newcomb, & Hartup, Note 1), it is unclear whether initial interdependencies based on competitive goal structures would carry over in this same manner. Even so, we conclude (as a working hypothesis) that carryover from the immediately preceding experience to the no reward condition is a general rule.

The individualistic strategies established under the undesignated goal structure emerged on some basis other than the children's immediate

experience with the task, since competitive goal structures were not encountered in the experiment prior to Phase II. These strategies must have been generalized from the wider social context. In school, rewards are commonly allocated proportionate to successful individual achievement. Both promotive and contrient structures are also encountered within the classroom, but the usual emphasis is individualistic (cf., Johnson & Johnson, 1975). Given that this experiment was conducted in schools and administered by a teacher-like graduate student, it can be argued that the individualistic interdependencies observed under the undesignated goal structure were created by the children themselves and were generalized from the structures encountered in their classrooms.

Could the children instead have been biased toward individualistic performance by the manner in which the undesignated goal structure was administered? Several arguments can be advanced to counter this hypothesis. First, the three feedback statements made during the undesignated session were delivered in random order and the children did not know the total number of different statements to be used. Trial-by-trial, the children could not surmise, in advance, the basis on which they would be rewarded or whether subsequent trials would be rewarded in the same manner. Such moment-to-moment uncertainty about the reward contingencies would preclude any overall interpretation in terms of one idealized goal structure. Further, because feedback statements were ordered randomly, the reward contingency during a given trial was independent of the actual status of the tower. For example, sometimes the tower fell over, leaving no blocks remaining, but the children were told that some would receive tokens and

some would not. The children often verbalized that they did not understand why a particular contingency was in effect, and various comments and questions indicated disagreement with the experimenter. In short, it seems improbable that the children mistook the undesignated situation as an individualistic goal structure as a consequence of an instructional set.

It was evident that experience under a contrient or individualistic goal structure did not affect performance under succeeding promotive structures -- with amount of practice controlled. Nor did experience under indeterminate goal structures influence performance in the subsequent promotive condition. Whatever strategies and roles were established via competition or individualistic effort, they did not carry over into later cooperative interaction. The children interpreted current task demands in terms of current goal structures, and transitions between cooperation, competition, and individualization were immediate.

Role differentiation, as indexed by the discrepancies among members in their contributions to the towers, was continuous over a relatively long period. Role relations established under the initial promotive goal structure were altered by the introduction of contrient, individualistic, or indeterminate goal structures, but when promotive goal structures were restored, discrepancy scores continued to increase.

Clearly, the sequential deployment of goal structures does not alone influence children's small group interaction; the effects on performance of alternating goal structures are extremely complex, with variations

stemming from both practice and social context. Future research, then, must be directed to the problem of elucidating both broad and specific contextual factors as these interact with immediate goal structures to affect performance.

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Footnotes

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[1]The shift groups received the first six trials under a contrient goal structure, and the second six trials under either a promotive or an individualistic goal structure. Comparison groups received all twelve trials under either the individualistic or the promotive goal structures.

Table 1
Intercorrelations Among Performance Measures
Separately By Phase

		Phase I			Phase II				Phase III			
		Blocks	Falls	Discrep-ancy	Alterna-tions	Blocks	Falls	Discrep-ancy	Alterna-tions	Blocks	Falls	Discrep-ancy	Alterna-tions
Phase I	Blocks		-.58***	.34**	.13	-.08	.08	-.11	.26*	.19	-.04	-.02	.15
	Falls			-.23	-.23	-.02	.15	.05	.29*	-.04	.04	.11	-.18
	Discrep-ancy				-.51**	-.11	.01	.05	-.04	.33**	-.20	.56***	-.32**
	Alterna-tions					-.03	.12	-.12	.27*	-.17	.15	-.45***	.38**
Phase II	Blocks						-.67***	.57***	.34**	.12	-.19	.00	.08
	Falls							-.36**	-.48***	-.02	.19	.02	-.12
	Discrep-ancy								-.16	.10	-.13	.14	-.10
	Alterna-tions									.07	-.17	-.18	.54***
Phase III	Blocks										-.79***	.36**	.02
	Falls											-.21	.07
	Discrep-ancy												.61***
	Alterna-tions												

*p < .05
**p < .01
***p < .001

Figure 1. Means for group performance under each goal structure condition in each phase.